

A Primer on Student Growth Percentiles

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Why Student Growth?

Following the 2001 reauthorization of the *Elementary and Secondary Education Act of 1965*, commonly known as the *No Child Left Behind Act* (NCLB), states were required to implement large scale testing of all students to an extent never before seen in the United States (No Child Left Behind Act of 2001 (NCLB), 2002). Starting with the 2005-2006 school year, NCLB required states to test students in reading and mathematics from grades 3 through 8 and at least once in grades 10 through 12. In addition, beginning with the 2007-2008 school year, states must assess students in science at least once in elementary, middle and high school. As a consequence, states find themselves buried in assessment data with mandates from state and federal policy makers to utilize the data to improve the quality of education.

Accountability systems constructed according to federal adequate yearly progress (AYP) requirements currently rely upon annual measurement of student *achievement* to make judgments about school quality. Since their adoption, such *status measures* have been the focus of persistent criticism (Linn, 2003; Linn, Baker, & Betebenner, 2002). Status measures, though appropriate for making judgments about the achievement level of students at a school for a given year, are inappropriate for judgments about educational *effectiveness*. In this regard, status measures are blind to the possibility of low achieving students attending effective schools. It is this possibility that has led some critics of NCLB to label its achievement mandates as unfair and misguided and to demand the use of growth analyses as a better means of auditing the quality of schools.

A fundamental premise associated with the use of student growth for school accountability is that “good” schools bring about student growth in excess of that found at “bad” schools. Students attending such schools—commonly referred to as highly effective/ineffective schools—tend to demonstrate extraordinary growth that is causally attributed to the school or teachers within the school. The inherent believability of this premise is at the heart of current enthusiasm to incorporate growth models into state accountability systems. It is not surprising that the November 2005 announcement by Secretary of Education Spellings for the Growth Model Pilot Program which permits states to use growth model results as a means for compliance with NCLB achievement mandates was met with great enthusiasm by states. (Spellings, 2005).

The primary thrust of growth analyses over the last decade has been to determine, using sophisticated statistical techniques, the amount of student progress/growth that can be justifiably attributed to the school or teacher. That is, to disentangle current *aggregate* level achievement from effectiveness (Braun, 2005; Rubin, Stuart, & Zanutto, 2004; Ballou, Sanders, & Wright, 2004; Raudenbush,

2004). Such analyses, often called *value-added* analyses, attempt to quantify the teacher/school impact upon student achievement (i.e., the teacher or school *effect*). It is important to note that most value-added analyses focus on the school/teacher level contributions to student growth without first quantifying how much a student has grown. Because of this, there is a disconnect between these existing growth analysis techniques and determination of how much a student has growth and/or whether a student has made “a year’s growth”.

This paper/presentation returns to the task of defining a year’s growth for each student. To do so, we introduce a normative quantification of individual student growth which we call *student growth percentiles*. These quantities, derived using quantile regression techniques, are easily interpretable descriptive quantities that allow for growth comparisons between all students regardless of the scale students are measured on. More importantly, growth percentiles can be criterion referenced *vis-à-vis* current growth-to-standard methodologies in order to establish qualifications of what is *enough* growth. The purpose of this paper/presentation is to introduce student growth percentiles and to demonstrate using state assessment data how current discussions of student growth lack a normative dimension necessary to set challenging yet attainable individual achievement goals. We assert that the establishment of a normative basis for student growth eliminates many of the problems of incorporating growth into accountability systems.

Student Growth Percentiles

It is a common misconception that to measure student growth in education, the subject matter and grades over which growth is examined must be on the same scale—referred to as a vertical scale. Not only is a vertical scale not necessary, but its existence obscures fundamental concepts necessary to understand growth. Consider the familiar situation from pediatrics where the interest is on measuring the height and weight of children over time. The scales on which height and weight are measured possess properties that educational assessment scales aspire towards but can never meet.¹

An infant male toddler is measured at 2 and 3 years of age and is shown to have grown 4 inches. The magnitude of increase—4 inches—is a well understood quantity that any parent can grasp and calculate at home using a simple yardstick. However, parents leaving their pediatrician’s office knowing only how much their child and grown would be wanting for more information. In this situation, parents are not interested in an absolute criterion of growth, but instead in a normative criterion the locates that 4 inch increase alongside the height increases of similar children. Examining this height increase relative to the increases of similar children permits one to diagnose how (ab)normal such an increase is.

Given this reality in the examination of change where scales of measurement are perfect, it is absurd to think that in education, where scales are quasi-interval, one can/should examine growth differently.

Supposing scales did exist in education similar to height/weight scales that permitted the calculation of absolute measures of annual academic growth for students, answers parents receive to questions such as, “How much did my child progress?”, would be met with a number of scale score points that would leave the parents confused wondering whether the number of points is good or bad. As in pediatrics, the search for a description of achievement growth that informs discussions is best served by considering a normative quantification of student growth—a *student growth percentile*.

A student’s growth percentile describes how (ab)normal a student’s growth is by examining their current achievement relative to their *academic peers*—those students with the same starting point

¹Height and weight scales are interval (actually, ratio scales) where a unit increase reflects an equivalent increase in the underlying quality being measured not matter where on the scale the increase occurs.

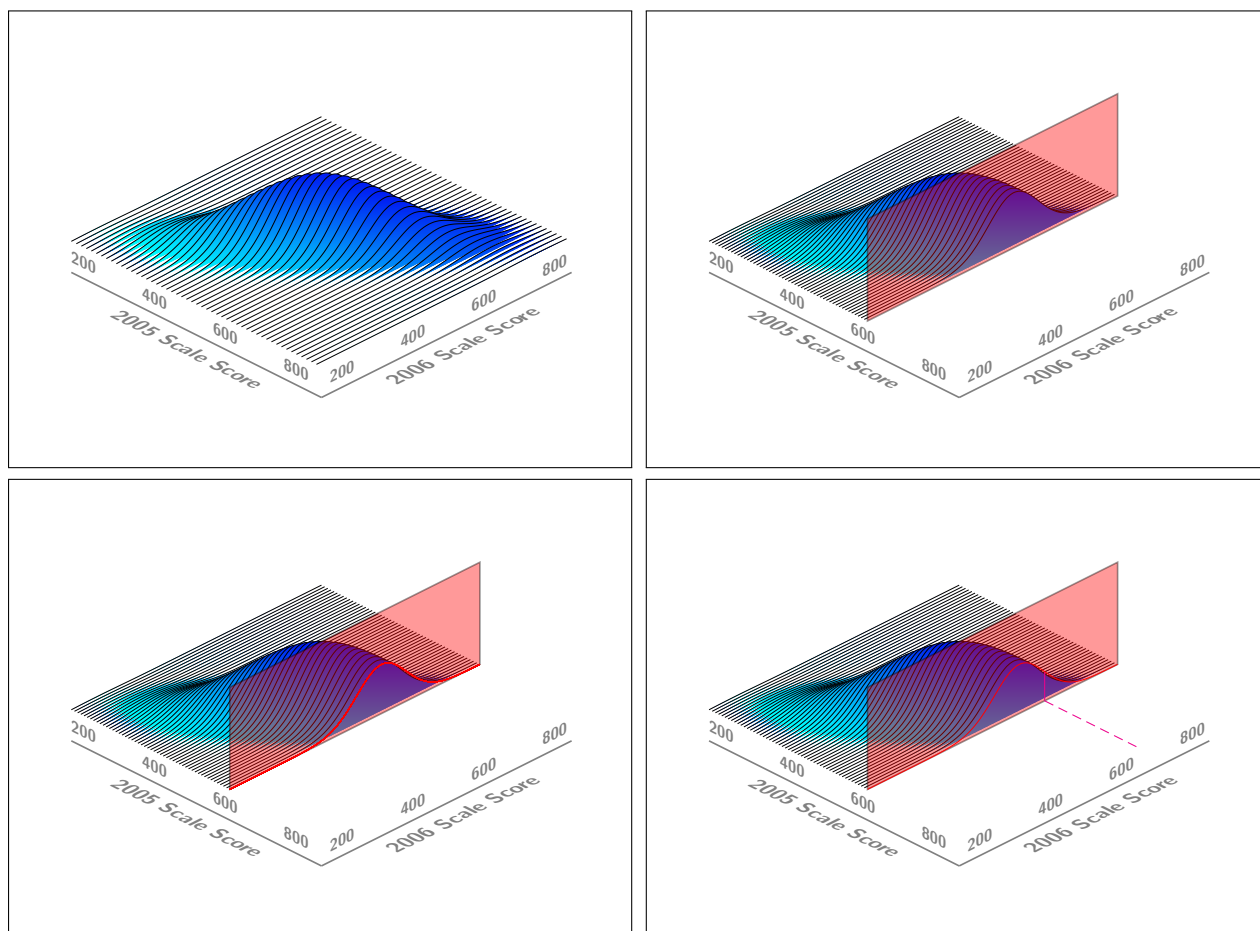


Figure 1: Figures depicting the distribution associated with 2005 and 2006 student scale scores together with the conditional distribution and associated growth percentile

demonstrating identical prior achievement. The four panels of Figure 1 depict what a student growth percentile represents. Investigating current achievement based upon prior achievement establishes a conditional distribution against which a student's current achievement can be examined. Students with achievement in the upper tail of the distribution have demonstrated high rates of growth relative to their academic peers whereas those students with achievement in the lower tail of the distribution have demonstrated low rates of growth. Students with current achievement in the middle of the distribution could be described as demonstrating "average" or "typical" growth. Qualifying a student growth percentile as "adequate", "good", or "enough" is a standard setting procedure that requires stakeholders to examine a student's growth *vis-à-vis* external criteria such as performance standards/levels.

School Level Results

An advantage of quantifying growth at the student level is that it is generally an easy task to combine the individual level growth results to retrieve a school level aggregate. For example, after growth percentiles are calculated for each of 500 students at a school, the distribution of growth percentiles for those 500 students represents how much the students at that school grew in the previous year. Summarizing this distribution's "average" would supply a single number describing the growth of student's at a given school on "average". Because it is not suitable to calculate a typical

average using percentiles, the median is used as the single number which best describes where the middle of the distribution of student growth percentiles lies.

If students were randomly assigned to schools, then the median growth percentile associated with a school would be expected to be 50. Schools with median student growth percentiles above 50 have students demonstrating greater than expected growth and schools with median student growth percentiles below 50 have students demonstrating less than expected growth. In this way, student growth percentiles can be used to identify schools where student growth is extraordinary. However, just like with student achievement for a school, it would be a mistake to assert that the school is solely responsible for the growth of its students.

Measurement of student growth and identification of responsibility for that growth involve addressing two distinct but related questions:

- How much the the students at this school grow/progress?
- How much did this school contribute to student growth?

The median student growth percentile is descriptive and makes no assertion about the cause of student growth. This differs from value-added and other models used for accountability purposes where the purpose is to exactly specify the contribution to student achievement provided by a given school or teacher. It is likely, and society would certainly like to believe, that schools and teachers have a significant impact upon student learning: That their efforts are reflected in the academic growth of students. The median student growth percentile is *one of many* indicators that stakeholders can use to judge the quality of the education students receive.

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